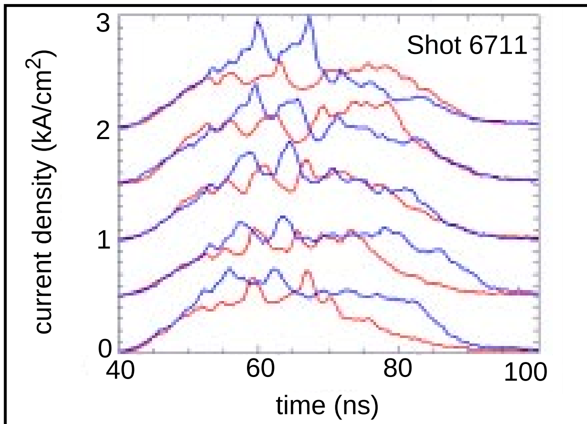
April 1995 Highlights of the Light Ion Inertial Confinement Fusion Program



Ion current density vs time from Faraday cups 7.5° apart in azimuth. Blue curves are for the top half of the diode; red, for the bottom. Hole closure causes the decrease in amplitude at late time.

Presentations on the light ion ICF program were given at the 12th International Conference on Laser Interaction and Related Plasma Phenomena and at the April general meeting of the American Physical Society. We are beginning to prepare for the ICFAC review in early June.

With a 5-mm-high blade projecting from the cathode feed of PBFA II, ion emission from the LiF anode occurs 5 ns earlier than without the blade. This allows us to use larger anode-cathode gaps and 20% higher applied magnetic fields than without the blade, which is acting as an early source of electrons. No heating or cleaning hardware was used in these experiments. For the first time, growth of a long-wavelength electromagnetic instability is clearly evident in small-aperture (0.75-mm-diameter) Faraday cup data (see figure). The instability is in the opposite phase on the top and bottom halves of the diode. The data also show that, for high anode current densities (> 700 A/cm^2), the amplitude of the ion current density waves increases dramatically and causes beam defocusing. The phase velocity of the waves (c/20) and the dependence of the instability growth on ion current enhancement (J/J_{CL}) are consistent with analytic instability analysis and particle-in-cell simulations. We are comparing the data with QUICKSILVER simulations and spectroscopic data.

A model has been developed for the RF system that delivers power to the PBFA-II lithium emission surface. A manual tuning circuit, designed with the model, matches the impedance of the cleaning plasma to that of the RF generator to reduce the reflected power that had caused failure of the RF components. With the new circuit, less than 3% of the forward-going power is reflected in tests on the Integrated Test Facility, as compared to 60% without the circuit. The heater system has been assembled and tested, and experiments to clean the lithium emission surface have begun.

We are conducting SABRE experiments to study the effects of microcharge non-neutrality on beam microdivergence. If neutralized only by electron trapping, small beam nonuniformities ($\lesssim 1$ mm, $\gtrsim 10$ A) can produce substantial beam microdivergence (~20 mrad and higher) and axial energy spreads. By expanding proton beams on SABRE, we have created beamlets with a microdivergence of 5 mrad. The beamlets will be propagated in gas at various pressures, and the resultant particle distributions will be compared with code predictions to assess the importance of this divergence mechanism.

A conversion factor for absolute intensity in the FY93 conical and FY94 cylindrical lithium-driven hohlraum experiments has been obtained by comparing time-integrated x-ray pinhole data to magnetic spectrometer data from two shots in the power coupling series on PBFA II. The relationship between the measured hohlraum temperature and absolute intensity for the two hohlraum geometries is being investigated and compared with analytic models and LASNEX simulations.

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Archived copies of the *Highlights* beginning July 1993 are available at http://www.sandia.gov/pulspowr/hedicf/highlights.